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# **Military Occupational Specialty (MOS) Restructuring: An Annotated Bibliography**

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MILITARY OCCUPATIONAL SPECIALTY (MOS) RESTRUCTURING: AN  
ANNOTATED BIBLIOGRAPHY

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MILITARY OCCUPATIONAL SPECIALTY (MOS) RESTRUCTURING:  
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Introduction

As a result of new or changed doctrine, equipment, or organization, new soldier performance requirements must be merged with existing military occupational specialties (MOS) and career management fields (CMFs). According to Major General Childs (1988), "Wholesale changes in career management fields to include civilian career programs are inevitable." Proceduralized decision aids are not available and are required to facilitate the development of optimal strategies for MOS restructuring. The decision aids should systematically address the following questions:

1. Does a new MOS need to be created to support a new system?
2. Should new requirements be merged with an existing MOS?
3. Does the family of branch MOS and CMFs need to be restructured?

Answering these questions requires tradeoffs between many criteria. These criteria include adequate support for the Army organizational (i.e., force) structure and equipment densities; geographical location; demographics; manpower usage; manpower ceilings; pyramidal skill level structure that meets Army ceilings on grade level percentages and properly supports career progression; time required for acquisition and sustainment training in the institution and the unit; potential for a more cost and training effective branch training system design; and soldier aptitude requirements. The decision aids must support tradeoffs between these criteria rather than suboptimization (e.g., optimizing individually on manpower usage, training time, or aptitude).

This bibliography provides information on technical reports from a review of literature, regulations, memoranda, and program descriptions concerning topics related to the question of how to restructure MOS. Manpower, personnel, and training issues were covered in the literature review. The literature review was restricted to those reports which were identified as being related to MOS concerns (e.g., searches were not done singly on such broad topics as cost models or task analysis). Only some of the above questions and criteria have been addressed by any of the reviewed documents. All articles covered only specific aspects of the MOS restructuring problem.

The review provided very useful information on successes and hazards associated with early efforts to address aspects of the MOS integration problem area. For example, Moore, Wilson, and Boyle (1987) quantitatively demonstrated the hazards of suboptimizing on manpower usage and training time separately. On another topic, it is generally agreed that the method one uses to perform task descriptions and analyses determines the possible outcomes. Drucker, Hoffman, and Bessemer (1982) demonstrated this through a study which identifies the differences between training solutions obtained as a result of using two different methods of task analysis. The review also revealed that some macro-level methods for dealing with parts of the MOS restructuring problem are currently in the developmental stage (Wilson, Faucheux, Gray, and Wilson, 1987 and Dynamics Research Corporation, 1987).

This review represents one of the first phases in a research program initiated at the Army Research Institute to investigate MOS restructuring issues and to develop decision aids (Finley and Sanders, 1988). The purpose of this bibliography was to provide one input to the definition of the program, and to give other researchers and personnel proponency staffs the information available to date and to provide a common basis for communication.

Annotations describing the reviewed documentation are arranged in alphabetical order by author within each of five sections. The sections, in order of presentation, are: MOS Restructuring; Generic Training; Manpower Costs; Manpower and Personnel Integration (MANPRINT); and Task Data Bases.

## Annotations

### MOS Restructuring

Boyle, E. Fact Sheet Concerning: SUMMA. Small Unit Maintenance Manpower Analysis. Wright Patterson Air Force Base, Oh.: AFHRL/LRC

The Small Unit Maintenance Manpower Analysis (SUMMA) objective is to develop a technology that provides alternate ways to increase maintenance manpower utilization by altering traditional occupational specialization so that wartime flying schedules can be achieved from dispersed operating locations without largely increasing manpower requirements. This objective demands an in-depth assessment of reduced maintenance specialization on current manpower, personnel, and training issues. The point of the analysis is to determine the tradeoffs between manpower savings due to reduced specialization and increased training costs and (or) policy impact associated with unit level changes.

SUMMA has a strong analytical foundation and is microcomputer based. SUMMA uses an LCOM database (a source for defining task-specialty combinations for an existing or emerging weapons system), which compares SUMMA answers to LCOM answers and gives analytical expression for simulation results.

The SUMMA process views the problem of locating improved tasks-specialty combinations as optimizing the task inventory (bundles) of each Air Force Specialty (AFS) maintaining a weapon system. After the Task Allocation Model (TAM) has determined new task-specialty bundles, the impact on individual AFSSs must be determined using MPT and COST statistics.

SUMMA is a technology to assess the impact of occupational decentralization on Air Force personnel resources with an underlying mathematical logic. It provides a model to study the impact of task-specialty changes and associated issues and is a task level tool that can provide integrated logistics analysis for other Air Force development efforts.

Childs, L.M. Memorandum regarding: U.S. Army Training and Doctrine Command Long-Range Planning Vision. Fort Gordon, Ga.: U.S. Army Signal Center and Fort Gordon, 1988.

This memorandum outlines General Childs' view of the issues of the TRADOC Long-Range planning vision as it applies to the Signal Corps. He believes that the Technology Base Investment Strategy (TBIS) as influenced by the Concept Based Requirements System (CBRS) will address the architecture, doctrine, and

associated technologies necessary to shape and transition the U.S. Army Signal Corps into the 21st century. He believes that the CBRS must drive and control the TBIS and he plans to use the CBRS to achieve that end.

In seven annexes which discuss the major planning issues, General Childs expands upon the major issues identified and develops perspectives to be considered. The 2020 Information Network Architectural Technological Objective furnishes the idea of a conceptual architecture run by and dependent upon advanced technologies resulting in an all encompassing network supporting light intensity to global conflict scenarios. This idea will determine the baseline and aiming stake which influences the remaining major planning issues.

In Annex D, General Childs discusses planning for the restructuring of Signal military and civilian career management fields. Since the Signal Corps will have fewer personnel and more specialized high-tech skills, wholesale changes in career management fields, including civilian career programs, are seen as inevitable. Since the Signal Corps will have a great need for people with strong analytical and math skills, the Army must adopt greatly improved recruitment and placement techniques. Research is needed to establish job skill profiles that will define cognitive, communicative, perceptual, and psychomotor aptitudes for each type of job. This applies to both civilian and military personnel of all ranks.

In Annex E, application of advanced technologies in individual and unit training is addressed. In order to minimize training costs and maximize performance effectiveness, a full array of advanced technological training approaches will be needed. Job performance aids, part task trainers, embedded training systems, intelligent tutoring systems (Artificial Intelligence (AI) based), and full mission simulators will also be needed. Training strategies of the future will grow from a device oriented approach towards a highly generic approach in order to maximally transfer training knowledge. Advanced technologies will also be applied to the assessment of individual and unit proficiency.

Department of the Army. Memorandum regarding Recommended Changes to the Military Occupational Classification Structure (MOCS).  
Fort Gordon, Ga.: U.S. Signal Center and Fort Gordon, 1988.

The purpose of the memorandum is to obtain approval for a change to the MOCS affecting 29J and 39T. The recommendation is to delete MOS 39T and ASI B3 from the MOCS and merge relevant MOS 39T tasks into MOS 29J.



MOS 39T (Tactical Computer Systems Repairer) is experiencing a drastic reduction in needed positions due to a new maintenance concept which strives to minimize repairs at forward maintenance facilities. Maintenance sections in signal units currently have no authorizations for MOS 39T, and this is not expected to change. MOS 29J will experience a major reduction in maintenance intensive devices as the Tactical Record Traffic System (TRTS) architecture minimizes Signal Corps over-the-counter message functions. The realignment of tasks from MOS 39T with MOS 29J will consolidate functions of two MOS that are seen to be unsupportable as two separate MOS into one MOS that will more efficiently provide electronic maintenance on telecommunications terminal devices and improve Army readiness (by minimizing single positions). The tasks associated with MOS 39T will become a short-term ASI for MOS 29J; this in lieu of formal transition training. After the number of untrained personnel decreases to less than 50%, the ASI will be deleted.

A summary of significant changes is listed. A proposed guidance for reclassification of positions is outlined as well as proposed course administrative data and proposed training strategy.

MOS 29J, Telecommunications Terminal Device Repairer, is discussed in terms of major duties, physical demands ratings and qualifications for initial award of the job, additional skill identifiers, and related civilian occupations. The physical demands task list is listed and the physical demands analysis worksheets for MOS 29J are included.

Dynamics Research Corporation. Extended Application of the HARDMAN Methodology to the Army's Light Helicopter Family Program (LHX) Technical Report, Addendum 3, MOS Consolidation Study Plan. Andover, Md.: Dynamics Research Corporation, 1987.

This report is an addendum to Volume I of the Application of the Hardware vs. Manpower (HARDMAN) Comparability Methodology (HCM) to the Army's Light Helicopter Experimental (LHX) System. This plan extends analyses from previous HCM applications to the LHX system and describes an Military Occupational Specialty (MOS) consolidation study plan that supports the MOS decision-making that fielding the LHX System requires. This study plan puts forth a methodology incorporating twelve decision parameters which measure the impact of changes to Career Management Fields (CMF) and MOS structures. The report also includes implementation strategies and resource estimates.

Despite the fact that the LHX has had one of the most thorough examinations of its MPT requirements, some questions remain. One of the most important questions is: What is the

needed MOS configuration for supportability? This study, which builds upon the finished LHX HCM Analysis, will provide the means to resolve this concern. The study, which contains two parts, the MOS Consolidation Study Plan and the MOS Consolidation Methodology, is generic and can be applied to the MOS structure for any Army weapon system.

The MOS Consolidation Study Plan, a prerequisite for conducting the analysis, is composed of 6 steps. The first four steps consist of analytic procedures for determining decision parameter results; in the fifth step the results are interpreted; and the last step contains ways for determining alternative CMF-MOS Structures. The Methodology follows the 6 HCM analysis steps with emphasis on the 12 parameters used for making MOS Consolidation decisions.

MOS Consolidation Study Plan. The study plan establishes the analysis parameters including decisions regarding: the study's scope, assumptions, objectives, methodology, configurations, and decision boundaries. A diverse group, such as the LHX HARDMAN Technical Advisory Group (TAG), that reflects all segments of the MPT community should formulate the plan since different segments of the community can view the feasibility and importance of consolidation from different perspectives.

The LHX system will be the first Army aircraft to use a two-level maintenance concept. To implement this concept, tasks now performed by different MOS will be consolidated into one user-level MOS structure.

The HARDMAN TAG defines the scope of the MOS Consolidation Study, which is intended to evaluate the TQQPRI (Tentative, Qualitative, and Quantitative Personnel Requirements Information) MOS consolidation assumptions, identify MOS that possess consolidation potential, and evaluate the consolidation data base and study approach. Certain assumptions are agreed upon such as: Army end-strength will remain constant and funding levels won't significantly change.

The three final objectives are: to develop an LHX MOS Consolidation data base, determine the feasibility of two MOS consolidation plans, and provide the Army with the capability to assess and adjust its MOS structure to best meet the LHX system's evolving requirements. A five-phase approach, outlined below, is used to accomplish these objectives.

Phase I: Decision parameter results are ascertained for three study configurations: the Predecessor System, the Baseline Comparison System, and Consolidation One. The data collection instruments and analytic models developed for steps 1 through 4 of the MOS Consolidation Methodology will be used.

Phase II: Analysts will identify MOS demands for further study consisting of decision parameters that require a high proportion of MPT requirements or that are in short supply.

Phase III: Analysts will choose an alternate structure, using a tradeoff procedure from Step 6 of the MOS Consolidation Methodology, which doesn't increase the critical MOS demand identified in Phase II.

Phase IV: The chosen CMF-MOS structure will be iterated through the requirements analyses of Steps 2 through 4 and new decision parameter results will be obtained.

Phase V: All the CMF-MOS structures will be compared and the most supportable structure will be chosen. If the results do not meet acceptable limits and no decision can be made, Phases III through V can be repeated.

Four configurations are required:

1. The predecessor system- which is used to assess the impact of new CMF-MOS structures on existing resources.
2. The Baseline Comparison System (BCS)- which uses the current MOSS.
3. Consolidation One CMF-MOS Structure- the MOS identified in the LHX TQQPRI.
4. Consolidation Two- an alternative CMF-MOS structure.

MOS Consolidation Methodology. The HMC provides the basic structure for the MOS Consolidation Methodology and provides the functional basis for determining qualitative manpower and training requirements and the data base for determining quantitative workload-based manpower requirements. This methodology consists of six steps which are discussed below.

1. Systems Analysis. This consists of four substeps: Mission Analysis, Functional Requirements Analysis, Equipment Comparability Analysis, and Reliability and Maintainability Analysis. Mission Analysis defines the missions that the system must perform. Functional Requirements Analysis determines the activities, tasks, and functions that the system must perform to execute its mission and also defines specific quantitative performance standards that the system must meet. Equipment Comparability Analysis establishes the specific equipment that will make up the system configurations. In this step equipment configurations are fully defined. Reliability and Maintainability (R&M) Analysis establishes the maintenance workload parameters will be used to calculate workload requirements in the manpower analysis.

2. Manpower Requirements Analysis. This determines the number and types of operator and maintainer positions (by paygrade and MOS) that the system will need. This analysis is conducted in three phases: MOS-Paygrade Determination, Workload Computation, and Manpower Requirements Determination. These subtasks establish the system's qualitative and quantitative manpower requirements.

3. Training Resource Requirements Analysis. The HMC Training Resource Requirements Analysis (TRRA) estimates training requirements, which specify task, course, and resource requirements and is conducted in three substeps: Task Comparability Analysis, Course Requirements Analysis, and Training Cost and Resource Determination.

4. Personnel Requirements Analysis. The purpose of this analysis is to estimate the total number of personnel required to sustain specific manpower requirements over time. This analysis is conducted in 3 substeps: Pipeline Requirements Analysis, which determines career paths for each MOS; Flow Rates Analysis, which identifies and analyzes the personnel flow rates associated with each MOS; and Personnel Requirements Computations, which determines the number of personnel required to enter each paygrade to offset losses. Each substep represents a separate requirement necessary to identify the steady-state personnel pipeline requirements and fulfills the promotion opportunity decision parameter.

5. Impact Analysis. In this step, the candidate CMF-MOS structure demands for MPT resources are compared to present and projected resource requirements. This analysis identifies high drivers for each parameter, determines resources, and allows a supply-and-demand comparison to be made.

6. Tradeoff Analysis. This step considers various changes to the system which can involve any aspect of the total system, especially changes to CMF-MOS structure. The purpose is to develop CMF-MOS consolidation candidates that can reduce the system's MPT impacts, as measured by the decision parameters.

Regarding decision parameters, fixed limits and weights can be applied to them to reflect their relative importance and they can also be tailored, depending upon data availability, desired accuracy, degree of MOS consolidation uncertainty, available resources, and time. These decision parameters are explored in some detail: first duty assignment utilization; promotion opportunity; test, measurement, and diagnostic equipment; space imbalanced MOS (SIMOS); length of school training; physical demands; manpower requirements criteria; transients, trainees, holdees, and students (TTHS) account; aptitude demands;

supervisors; and security clearance. Each decision parameter is described and there is a flow chart of the procedure, data inputs, analysis process, output, and sample report formats.

In the last section, resource requirements for implementing the proposed MOS Consolidation Plan are presented. Three estimates are presented: costs for applying the methodology to all existing and emerging Army aircraft, for developing the support software, and for an implementation strategy.

Finley, D.L. and Sanders, M.G. Project Fact Sheet Concerning Soldier Military Occupational Specialties (MOSS) and Career Management Fields (CMFs) for New Signal Systems. Fort Gordon, Ga.: Army Research Institute, 1988.

The project's objective is to develop a procedural model to help make decisions regarding restructuring of MOS and CMFs and to help ascertain the aptitude and training requirements needed for the new specialties. Through the use of contractual support, the Army Research Institute will execute a three phased research program.

In Phase I, Army regulations, existing Manpower and Personnel procedures, and currently available MOS issue-related methods will be evaluated to determine completeness, potential for integration, and degree of augmentation required to provide a specific and effective procedural model that addresses the above issues. Deficiencies and actions to correct them will be identified.

In Phase II, using the results of Phase I, a procedural model which builds on procedures (with deficiencies corrected) from Phase I will be created.

In Phase III, the completeness and effectiveness of the model will be validated through application to two new Army communication requirements and to a new civilian job requirement. The model will be refined as required.

This model will augment existing Army and TRADOC regulations addressing personnel requirements issues and will be integrated into future MANPRINT documents for use Armywide.

Headquarters, Department of the Army. Enlisted Career Management Fields and Military Occupational Specialties. Personnel Selection and Classification. Army Regulation 611-201. Washington, D.C.: Headquarters, Department of the Army, 1987.

This regulation sets down the enlisted military occupational specialty classification structure of the United States Army. Career management fields in this regulation are the basis for the management of enlisted personnel. Only the military occupational specialties in this regulation will be used in personnel classification, authorization documents, or reports of authorized and operation troop strength. This regulation applies to the Active Army, the Army National Guard, and the United States Army Reserve. It specifically applies to proponent agencies involved in career management and field management and military occupational specialty classification and structure.

Headquarters, Department of the Army. Military Occupational Classification Structure (MOCS) Handbook. Washington, D.C.: Headquarters, Department of the Army, 1988.

This handbook describes and illustrates procedures and guidelines for developing and processing MOCS actions affecting commissioned officers, warrant officers, and enlisted soldiers. It applies to the Active Army, the Army National Guard, and the U.S. Army Reserve. It applies to all proponent agencies responsible for developing and implementing the military occupational classification structure.

The personnel proponent is required to complete a detailed analysis prior to submitting a proposed revision to AR 611-101, AR 611-112, or AR 611-201. To ensure that a total evaluation and impact assessment is complete, specific items must be addressed. This analysis must be included as part of the MOCS proposal and consist of the following information.

Background and Rationale. This information must be presented in a way to fully inform the reader by providing a narrative description of the change and reasons for the change. This brief statement must include the who, what, when, where, why and how of the proposal.

Summary of Significant Changes. An indepth analysis to include all significant changes and areas of impact must be conducted. The analysis will be condensed into concise statements and must be included as an enclosure to the recommended change. Areas to be considered include:

1. Identifier specifications to include qualifications.

2. Changes to the Standards of Grade Authorization (SGA) for enlisted, Rank Coding Tables for warrant officers, and Officer Grade Tables for commissioned officers.

3. Changes to associated identifiers.

4. Improvements or changes in grade feasibilities.

5. Changes to Physical Demands Rating (enlisted only).

6. Impact on female soldiers.

7. Impact on recruiting (enlisted only).

8. Impact on training strategy.

9. Impact on training base.

Position Data Analysis. The proposal must include a detailed analysis of the positions affected by the revision. The SGA doesn't authorize positions but provides grading for authorized positions. The grade structure analysis must be expressed in number of authorizations, by grade and aggregate, for the present and proposed structure. Any increase or decrease in authorizations caused by another action should be included. The data source and date of document used to develop the proposal must also be included. In performing the analysis, consideration and grade structure analysis must be made based on the current year plus two years in the future.

A comprehensive grade structure impact should be included by MOS for the current documents as well as any changes projected for future years. The recommended grade structure must be detailed and reflect a comparison of current and proposed. If the proposed SGA includes an upgrade from the current structure in any grade above E4, a trade-off position must be identified.

Documentation must include extracts of each TOE and TAADS where the affected positions are identified. The proposed change will be annotated on the document to show new duty position title, grade and MOS.

Personnel Data Analysis. An assessment as to the impact the revision will have on personnel supportability is required. This includes:

1. MOS from which personnel can be accessed and (or) the MOS in which the soldier can expect to progress for promotion to the next higher grade should be indicated.

2. A statement regarding whether or not the MOS is a space imbalanced military occupational specialty (SIMOS) and what

impact, if any, the proposal will have. (Does the restructuring alleviate the problem, worsen it, or cause the MOS to become SIMOS?)

3. The impact of assignment or utilization of female soldiers resulting from the revision must be stated.

Recruiting Impact. The recruiting impact must be assessed. If the revision changes the qualifications or training, the U.S. Army Recruiting Command (USAREC) may need to renegotiate enlistment contracts. The impact of the revision to the Joint Optical Information Network (JOIN) must be determined to decide if the JOIN must be changed. If the revision changes an MOS Code, MOS title, skill level one tasks, and most difficult physical tasks, then a revision must be undertaken.

Impact on Military Occupational Classification Structure (MOCS) Identifier Duties and Tasks. The impact of the proposal on the MOCS identifier duties and tasks must be determined by the proponent. A statement should be included with the proposed change to indicate that the most recent Army Occupational Survey Program (AOSP) results were used, to the maximum extent possible.

Assessment of Training Needs and Proposed Strategy. A proposed or approved training strategy for the Active and Reserve Component soldiers must be included for new occupational identifiers or if new tasks are added to an existing identifier. As a minimum, the totals for the past two years and the projected numbers for the succeeding two years for the following areas must be provided:

1. Current and projected total numbers of soldiers to be trained annually.
2. Length of current and projected training.
3. Number of classes per year.
4. Number of students per class.
5. Any increase or decrease of trainees, transients, holdees and students (TTHS) or instructor requirements.

Copies of the proposed or approved Course Administrative Data (CAD) is required when proposed changes affect recruitment, retention, and (or) training. When minor changes are made no CAD is needed; the changes are simply reflected on the Program of Instruction (POI) preface page.

Position Documentation and Personnel Reclassification Guidance. The Personnel Proponent should submit information for consideration in developing guidance to include timeliness,



training required, constraints, "grandfathering" for reclassification, etc. This information will be evaluated and considered by SSC-NCR in developing guidance for concurrence of USTAPA and approval by ODCSPER.

Physical Demands Analysis (PDA). The MOS physical demands analysis is a detailed assessment of physical work requirements for every entry level MOS. Its purpose is to classify each MOS according to work requirements as they are required to be performed under combat conditions. The general objective of MOS Physical Demands Analysis is job-related support for the gender-free screening of soldiers. These worksheets are required for all skill level one tasks.

To determine the physical demands of an MOS, each task should be analyzed by proponents to identify explicit and implicit tasks. The most physically demanding task for each MOS must be identified. A PDA worksheet has been devised and is included in AR 611-1 to assist in recording the physical demands of the considered MOS.

Headquarters, Department of the Army. Military Occupational Classification Structure Development and Implementation. Army Regulation 611-1. Personnel Selection and Classification. Washington, D.C.: Headquarters, Department of the Army, 1988.

This regulation sets down the method of developing, changing, and controlling the commissioned officer, warrant officer, and enlisted Military Occupational Classification Structure (MOCS). The regulation applies to the active Army, the Army National Guard, and the U.S. Army Reserve. It also applies to all proponent agencies responsible for military occupational structure and classification.

Moore, S.C., Wilson, E.B. and Boyle, E. Aircraft Maintenance Task Allocation Alternatives: Exploratory Analysis. Wright Patterson Air Force Base, Oh.: Air Force Human Resources Laboratory, Logistics and Human Factors Division, 1987.

This project outlines an alternative in which maintenance specialties are restructured so that technicians would have wider ranges of skills. This is designed to permit high sortie generation rates at dispersed operating bases and to avoid the high costs of a much larger maintenance workforce. With this alternative, fewer persons could cover the range of tasks required at dispersed bases and the amount of time technicians spend waiting for tasks could be reduced. The idea is that maintenance manpower productivity can be improved economically so that wartime flying schedules could be met from dispersed

operating bases without increasing manpower. This paper demonstrates that both operational and human resource management considerations can be united in a logical approach that can identify optimal task allocations-specialty structures.

Using the Logistics Composite Model (LCOM), sortie generation rates are shown to be preserved with about half as much maintenance manpower if the current 30 work centers manned by 18 specialties were consolidated into 6 work centers manned by 6 specialties. This manpower saving is even greater if the aircraft were operated from dispersed bases.

To consider additional human resource management factors, such as requirements for higher mental aptitudes, longer initial training, and skill sustainment practice, a comprehensive data collection and analysis system is outlined called Small Unit Maintenance Manpower Analysis (SUMMA). This system can also help the Air Force to improve its maintenance task allocation-specialty structure. SUMMA would be used to: specify the operational and maintenance requirements that technicians must support; collect and estimate detailed cost-effectiveness data pertaining to individual tasks, current specialties, and general manpower categories; and apply integrated models to help users select alternatives by evaluating and optimizing the diverse effects of potential task allocation-specialty structure changes.

This paper defines the research problem, presents the results of exploratory analyses that confirm the importance and complexity of the problem, outlines the structure of a general system for addressing the problem, and identifies major conceptual issues that remain to be decided. Three additional reports will be produced later in the project, tentatively titled "Dispersed Combat Operations and Candidate Assignments of Tasks to Maintenance Specialties", "A Model for Optimizing Aircraft Maintenance Task/Specialty Allocations", and "Maintenance Personnel Requirements for Dispersed Operations".

Office, Chief of Ordnance. Electronic Maintenance Structure Study (ELMS) Draft Final Report. Aberdeen Proving Ground, Maryland: Office, Chief of Ordnance, 1986.

This study reviews and evaluates the Army's electronic maintenance functions, including concepts, doctrine, training, organization, proponentcy, and MOS structure. The results will be used to help change the current Army electronic maintenance support structure into a system that optimizes resource allocations, capitalizes on current technology, and more efficiently and effectively supports the Army's modern weapon systems.

The study covered most electronic maintenance operations in the Army maintenance system framework. The primary focus was on field operation for units in the European environment with the Army of Excellence force structure using the Air-Land Battle scenario. The investigated time frame was current through the 1990's.

The main goal of the study was to provide a way of improving the Army's electronic maintenance structure. This goal included several secondary efforts, which included optimizing resource allocations (people, tools and equipment, and spare parts), capitalizing on use of current technology, reducing the number of electronic maintenance-related Military Occupational Specialties (MOS) and Additional Skill Indicators (ASI), improving the efficiency and effectiveness of electronics maintenance training, and, if possible, reducing personnel and equipment.

The study evolved through three phases: data gathering, alternative formulations, and alternative evaluation. The data-gathering phase involved a literature search, field surveys, and fact-finding visits. Alternative maintenance concepts, personnel structures, and training strategies were formed from the literature reviews, surveys, and visits. The concept and structure alternatives were evaluated against the Model Force in a European scenario, and the training alternatives were evaluated from a cost and effectiveness standpoint.

The model force used in the study represented a "typical" corps with a slice of the echelon above corps (EAC). Concordant with the study plan, Europe V Corps and Air-Land Battle reference scenarios were used in the modeling process. The corps was composed of one armor division, three mechanized divisions, and one light infantry division, with all supporting elements. The EAC reflected all the Table of Organization and Equipment (TOE) units that would support the corps.

By combining the density of each type of equipment in the model and the Manpower Requirements Criteria (MARC) data, the study team arrayed the equipment in descending order of annual maintenance man-hours (AMMH). In analyzing all 1,946 equipment line item numbers (LIN) in the force, it was found that 2% of the equipment LIN accounted for 50% of the AMMH. At the other end of the spectrum, 51% of the LINS accounted for 1% of the AMMH. Overall, electronic maintenance represented 19.4% of all work load in the model force. Next, the study team concentrated on items that were electronic maintenance high drivers. There were 1,181 electronic LIN in the model force. On the high end of the array, 4% of the electronic LINS accounted for 50% of the AMMH, while 54% of the electronic LIN on the low side of the array equaled about 1% of the total electronic maintenance AMMH.

The LINS which represented only 1% of the total AMMH were often very critical one-of-a-kind pieces that had to be studied as carefully as the items which required most of the AMMH.

In order to evaluate the logistics aspects of contingency plans and force structure, the U.S. Army Logistics Evaluation Agency (USALEA) has developed an automatic technique called PROLOGUE which provides the capability for planners to simulate a military confrontation at predetermined locations around the world. Using PROLOGUE, the ELMS team was able to simulate the buildup of forces in Europe and then evaluate the logistics support aspect of the buildup. The reports, divided into segments by maintenance levels, provided MOS densities and locations within the force, its identity of each LIN supported by MOS and total number of items per LIN, the number of supervisors and direct labor assets, and the stratification of the MARC requirements to TOE required strength.

In order to reduce the enormous number of possible MOS combinations that could be studied, these combinations had to be reduced to a manageable size in which only those combinations with a high payoff potential were considered. To find an objective method of quantifying the similarity between apparently different MOSs, the study team conducted two field surveys, "The Group Survey", and "The Delphi Survey". The Group Survey, answered by subject matter experts (SME), produced a match rate ratio indicating similarity between MOS in four areas: basic electronic skills, knowledge, test equipment, and the total. Those MOS combinations with high match rate ratios comprised the initial list for further analysis by the team. The results of the Delphi Survey, not used due to problems with performing statistical analysis because of small sample sizes, was retained as a backup.

The team reviewed available Programs of Instruction (POI) for electronic maintenance courses and converted their contents into standard terms and topics. The information was arrayed in a matrix, with the x-axis listing the MOS and the y-axis listing the topics. From this matrix, information was obtained about the total basic electronic training (BET) hours per MOS, the average BET hours per MOS, the total hours per topic, the average hours per topic, and the frequency of BET topics covered by each MOS.

The USAREUR Support Structure Study (US3) was conducted to reexamine logistics support to USAREUR. The objective of the US3 was to identify, evaluate, and recommend near-term (5-year) and far-term (15-year) methods of realigning support structure in Europe to enhance combat capability while minimizing the requirement for support spaces to improve overall effectiveness.

One of the main objectives of the ELMS study was to develop a more efficient and effective MOS structure to support weapon systems. The corps model was used to generate equipment and personnel densities, workload requirements, and battlefield dispersion data to help evaluate the feasibility of alternative MOS structure. These data were subsequently used to evaluate each potential combination of MOS against the preferred alternative support structures. The following data were used to evaluate possible MOS changes: Group survey correlations such as skill, knowledge, and test equipment; training requirements; work-load requirements; equipment location on the battlefield; technological differences of systems; and TOE personnel strength and battlefield location. The study group also considered equipment modifications, unit structure changes, and TMDE improvements. To summarize the recommendations: the proposed MOS eliminations and consolidations result in a reduction of MOS from 104 considered to 55 by the year 2000.

The study also addressed the Electronic Maintenance policy, concepts and doctrine. This was necessary since there was non-standard application of concepts and doctrine in the operational theater. Support concept evolved system by system. The result is a complex electronic logistical support structure which neither optimizes logistical resources nor supports evolving technology. Consequently, the current electronic maintenance structure cannot effectively support airland battle doctrine. The team found the Army has a solid electronic maintenance policy but the implementation of the policy is fragmented and "everyone is in charge." The team therefore recommends that a process be established and an organization be designated to coordinate and integrate the implementation of electronic maintenance policy across Major Commands. In analyzing TRADOC, the team found that there are multiple voices speaking for TRADOC on electronic maintenance requirements, concepts, doctrine, and training. There is not a distinct management and control element for electronic maintenance within TRADOC. This results in an adverse impact on training, organizational design, TMDE training and distribution, technical training and MOS proliferation. The team recommends that a "Czar" be appointed to manage and control electronic maintenance matters, doctrine development, training, and coordinate issues both internal and external to TRADOC.

The Manpower Authorization Requirement Criteria (MARC) process provides for the development of HQDA approved standards for determining minimum essential wartime position requirements and for Combat Support (CS) and Combat Service Support (CSS) functions, in Tables of Equipment/ Modification Tables of Equipment (TOE/MTOE). Since MARC is the sole HQDA approved standard for ascertaining CS and CSS position requirements, the team exhaustively investigated the validity of MARC. The team found that MARC is the only standardized work-load determination system, MARC inputs are weak, excessive time is needed to conduct

a MARC study, and overall MARC data are suspect. According to the team, this causes a potential situation for TOE developers to place the wrong skills in wrong locations in wrong quantities.

In evaluating the Levels of Maintenance Concept, the team noted that there is a noticeable trend in industry and the Department of Defense to reduce the current levels of electronic maintenance. The team recommends that a two level maintenance system (unit/operator and a depot type function) should be a goal for future maintenance concepts for electronic items.

In 1986, GEN Richardson approved the ELMS recommendations for implementation. An action plan was then developed by the study team. The plan included the following recommendations:

1. Conduct a special functional review to evaluate the proposal by ELMS to reduce electronic maintenance MOS from 104 to 55.
2. Revalidate ASVAB areas aptitude selection criteria for electronic MOSs.
3. Recruit by CMF or functional area for electronic and other high technology MOS.
4. Implement preservice technical training program for selected electronic MOS in two phases- a pilot, and a follow on program.
5. Establish a system that allows an electronic technician to remain in technical positions through E9.
6. Standardize and consolidate some basic electronic training (BET).
7. Transition AIT courses for electronic maintenance MOS from task-based training to knowledges and skills based training.
8. Develop a plan and task an organization to integrate the implementation of electronic maintenance policy across Major Commands.
9. Establish as Army Doctrine a true three-level system for electronic maintenance.
10. Establish U.S. Army Logistic Center (LOGC) as TRADOC executive agent for all electronic maintenance.
11. Re-emphasize LOGC rule as TRADOC executive agent for Test, Measurement, and Diagnostic Equipment (TMDE).

12. Establish a responsive customer assistance program for electronic maintenance.

Sorensen, H.B. Statement of Work of the Specialty Structuring System (S3). Brooks Air Force Base, Tex.: Development Manpower and Personnel Division, Air Force Human Resources Laboratory, 1988.

The work statement addresses the preliminary development of analysis methods and software to optimize the effectiveness and efficiency tradeoffs between Manpower Personnel and Training (MPT) resource requirements in structuring tasks into jobs and jobs into specialties. The project will use the Small Unit Maintenance Manpower Analysis (SUMMA) technique as a beginning point and will add personnel and training tradeoffs to the maximizing function. The end-product techniques should be able to be used for existing jobs related to emerging weapon systems at any stage of the acquisition process.

SUMMA is a clustering technique with software developed to restructure tasks into jobs and jobs into specialties. This process uses LCOM task data and SME or project manager input to structure AFSSs which minimize manpower requirements and maximize sortie generation in a combat situation. Although a significant step towards structuring efficient Air Force Specialties (AFSSs) SUMMA doesn't integrate personnel and training issues in the objective function when structuring the AFSSs.

This project begins the developmental process for a specialty structuring system which considers MPT tradeoffs while clustering tasks into jobs and jobs into specialties in order to maximize work efficiency while minimizing weapon system life cycle support costs. The specific objective is to integrate the SUMMA AFS structuring process with personnel and training tradeoffs. The MPT data will be integrated with SUMMA technology and initial software will be developed so that contract users and monitors can critically evaluate the design specifications.

In Phase I, a research plan will be developed in which a weapon system to be used will be selected, an initial design proposal will be developed, user requirements will be assessed, and a project brief will be delivered. In Phase II, the S3 demonstration will be developed. Based on patterns developed (the geometric configuration of possible model element interrelationships), a microcomputer software package from at least one complete pattern will be developed. Then the system will be demonstrated. The deliverables will include a draft users manual, data, and software.

Sorensen, H.B. and Dart, T. Program Summary of the Specialty Structuring System (S3). Brooks Air Force Base, Tex.: Manpower and Personnel Division, Air Force Human Resources Laboratory.

This program will develop an Air Force specialty structuring system (S3) that will consider the manpower, personnel, and training tradeoffs while clustering tasks into jobs and jobs into specialties. This design will maximize work efficiency while minimizing weapon system life cycle support costs. This system will have the capability of working with macro-level MPT requirement estimates for use by planners during the pre-concept and concept development phases of the acquisition process. S3 should also have the capability of working with micro-level data during the full-scale development process of a weapons system as well as for current operational systems.

The final product will be a set of alternate patterns for integrating manpower, personnel, and training tradeoffs into a S3 prototype, which will provide an automated decision tool for managers to assess MPT tradeoffs prior to deployment of a new weapon system.

Wilson, M.G., Faucheux, G.N., Gray, J., and Wilson, E.B. A System of Models for Optimizing Aircraft Maintenance Task/Specialty Allocations. Reston, Va.: Advanced Technology, Inc., 1987.

The objective of this third Small Unit Maintenance Manpower Analysis (SUMMA) paper is to present and integrate methods of analyzing the impacts of maintenance job restructuring. This paper describes a Decision Support System (DSS) which:

1. Uses mathematical optimization procedures to determine the best definition of maintenance specialties and the task allocations to those specialties in light of user-specified constraints.
2. Provides an output to the Logistics Composite Model (LCOM) in order to verify and evaluate the operational capability obtained with the derived task-specialty allocation.
3. Evaluates MPT and cost impacts for the specified task allocations.

In summary, this paper describes the DSS, which closely follows the original concept, except that now it is more concrete. The SUMMA DSS uses a task allocation model based on a mathematical analysis of the maintenance process. This is used to derive a task-specialty assignment that will achieve the desired sortie rate using minimum manpower while concurrently



meeting other user-specified constraints. The operational capability of the task allocation is then verified using LCOM. Additional models subsequently evaluate the impact of the task allocation on key MPT variable; for example, formal training, on-the-job training, ASVAB requirements, etc. Finally, an estimate of the costs of the new task-specialty structure and a comparison to the cost of the current structure is provided.

LCOM is the chosen simulation model which evaluates the sortie rate achieved by the revised task-specialty assignment. The LCOM maintenance network data is used to provide basic task identification and maintenance network flow data to establish the analytical data base for the SUMMA models. The task and Air Force Specialty (AFS) characteristic-substitution data (collected in the field) are then added to the database for use by the models. The database was structured using the Revelation Database Management System, which provides the framework for the data and for the programs of the various models which are incorporated into the system.

Using a family of utility programs developed especially for this research, the interface between the SUMMA and LCOM is obtained. Summa has been designed to be easily inserted directly into the current Air Force maintenance-manpower requirements determination process. This will allow planners to use SUMMA for task-specialty restructure analysis as a part of the current manpower requirements process, in addition to other applications, such as investigations of relationships between job performance aids, training modes and task-specialty allocations, or the effect of reliability and maintainability improvements on task allocation and manpower requirements. Due to the SUMMA LCOM interface, the DSS may also be used in MPT resource planning during the design and development phases of new system acquisition.

### Generic Training

Allen Corporation of America. Generic Task Methodology and Sample Inventory. Alexandria, Va.: Allen Corporation of America, 1988.

The objective of this paper is to describe an analysis methodology that, when applied to a certain subject area, will produce the information needed to design, develop, and evaluate an efficient, effective generic training program. This methodology will be used to analyze the tasks of two MOSs which are to be merged. These MOS (31M and 31Q) are associated with the operation and maintenance of the Digital Group Multiplexer (DGM) communication system.

The focus of generic training is to stress the cognitive aspects of task performance, as opposed to specific procedures. To accomplish this, supporting analysis must identify the knowledge, skills, and attitudes (KSAs) related to task performance. The objectives of generic training include: increased knowledge retention, increased transferability of knowledge from one system or process to others, and increased training efficiency. To accomplish this, the analysis must identify the common KSAs that exist across equipment systems and job tasks. Tasks must be defined at the correct level of specificity as tasks defined too specifically won't reveal the KSAs associated with the interrelationships that exist at the system level while tasks defined too broadly won't reveal the KSAs that are unique to equipment items or procedures. The analysis methodology uses a repetitive process to identify the KSAs associated with the job and ensures that tasks are defined at the proper level of specificity by systematically identifying equipment and KSA commonalities that exist across the job tasks.

The first step in the process is to conduct a job analysis in order to gain a comprehensive understanding of the job. This establishes the domain of the analysis and describes all tasks performed by the incumbent. This list of tasks serves as a basis for completing the task analysis, equipment analysis lists (Step B), revised task inventory (Step C), and the final task inventory (Step E). Initially, these tasks are broadly defined; tasks defined at an intermediate level will be developed in Step C, and a final task inventory will be developed in Step E.

In Step B (the equipment analysis) equipment structures and commonalities are identified. The steps are to: identify items that are physically identical; analyze items for common function and operation, and judge their commonality; construct a final matrix at the highest level of commonality; and produce the equipment list. (This detailed list showing commonality serves as the basis for the revised task inventory.) The equipment list defines the scope and details the structure of the equipment operated or maintained by that specialty at a level that shows where the equipment is sufficiently different to demand separate training. Numbers are used in the matrix to indicate commonality or differences.

In Step C, a comprehensive, revised task list is developed, the purpose of which is to define all tasks performed by the specialty area at a specificity level consistent with equipment commonalities. The first step is to list all actions that are or can be performed on the equipment contained in the final equipment list by the job incumbent. Any equipment that is not acted upon or is beyond the job scope is eliminated. Finally, the inventory is reviewed and tasks are combined into broader tasks (if possible) as long as they don't exceed the level dictated by the equipment analysis. Tasks are rewritten for

clarity, if necessary, and any trivial tasks are eliminated. This revised task list is at a level of specificity determined by equipment commonalities and is a prerequisite for developing the final task inventory in which KSAs profiles are compared across tasks (Step E).

In Step D, a comprehensive KSA list is developed so as to establish the domain of the KSAs. This KSA list can be determined by using a job aid and the equipment analysis; a task analysis may be used to supplement or check the list to ensure completeness. (As long as the equipment remains the same, the list will be valid.) KSAs are clustered into five categories: Intellectual Skills, Cognitive Strategies, Verbal Information, Motor Skills, and Attitudes. Intellectual Skills are further broken down into five levels of complexity: Discrimination, Concrete Concepts, Defined Concepts, Rules, and Higher Order Rules. Arranged within categories from broad to specific, levels of specificity are ascertained and unimportant KSAs are eliminated. The KSAs are coded for use in a data base used to compare KSA profiles across tasks. This comprehensive KSA list is a prerequisite to comparing KSA profiles across revised tasks (Step E) and becomes a key tool for the training designer.

In Step E, KSA profiles across tasks are compared in order to cluster tasks with like KSA profiles. Using the output from Steps C and D, a matrix of KSAs versus revised tasks is identified. The broadest level where clusters contain like KSAs are identified and the matrix is rearranged (as necessary) to show commonalities. The clusters, if any, are named. This final task inventory produces a matrix of clusters of tasks with like (or similar) KSAs and is the task list from which tasks for training will be selected.

In Step F tasks are selected for training. The purpose is to determine which tasks require formal training and to designate the training site. Information is obtained from task inventory, Step E, and Subject Matter Expert Task Ratings. A Task Selection Board is established which reviews the task inventory, task rating criteria, and selection model as well as any data and references required by the board members. The SMEs rate all tasks on the inventory, apply the task selection model, and compile the list of tasks selected for training, including the designated site. Possible rating criteria include, but are not limited to: percent of job incumbents performing the task, percent of time spent performing the task, consequences of inadequate performance, task learning difficulty, difficulty of performing the task, and task importance. The final product of this step is the Critical Task List.

## Manpower Costs

BDM Services Company. Final Report. Army Manpower Cost System (AMCOS). Economic and Budget Cost Models. Monterey, Ca.: BDM Services Company, 1985.

Since accurate estimates of the cost of manpower by Military Occupational Specialty (MOS) and pay grade have become increasingly important in manpower planning, personnel management, and weapon system design, a group of models was developed for the Army Manpower Cost System (AMCOS). This report describes two models: the Enlisted Economic and Budget Cost Models. The former provides economic estimates of manpower cost, while the latter gives budgetary cost estimates. Estimated costs for all phases of an enlisted soldier's career have been estimated for all grades and skill specialties. A prototype Management Information System (MIS) has been devised to help access the voluminous cost data produced. The results show that development of the full AMCOS is both needed and practical.

Army Cost Factors Handbooks, which provide budget costs per soldier have been commonly used for manpower cost analyses. However, they do not identify the variations in manpower costs due to different specialties and different pay grades and cannot be used for detailed analyses. Due to this deficiency, a family of models for estimating manpower costs, to include estimates of both the real cost and the budget cost of adding or removing manpower positions from the force (marginal cost), has been developed. These models will also project estimates of the cost of a person in a particular pay grade and specialty. A set of Life Cycle Cost Models will support analysis of the investment in human capital through expenditures on accession and training. AMCOS will deal with enlisted, warrant, and officers of the active forces, enlisted personnel and officers in the Reserve and Guard components, and general schedule and wage board civil service employees of the Army.

The model is an extremely large data set, a census of cost estimates for Army enlisted personnel. Since the volume of cost data produced by each model is too great to make paper documentation impractical, a prototype software for a Management Information System (MIS) has been constructed to facilitate use of the data. Cost estimates for each MOS is accessed on two pages of data: the first page contains estimates of annual economic manpower position costs, and the second gives estimates of annual budget manpower position costs. Each page breaks out costs for every pay grade in an MOS.

This prototype MIS helps in estimating the budget or real cost of Army units. The user specifies the number of positions for each MOS and paygrade making up a unit. The AMCOS MIS produces tables showing aggregate costs for each unit, adding

together all MOSSs. These cost aggregates can be shown either as average cost for all members of the unit (by paygrade) or as the sum of all individual costs. Unit composition tables are also produced.

AMCOS allows a more detailed analysis of the cost components of each category. For example, a user could analyze accession costs, detailing the separate costs of recruiting, enlistment bonuses, equipping, basic and initial entry training, advanced individual (level one) training, and accession Permanent Change of Station (PCS) move costs. The Rotation category could reveal the separate influence of rotation moves and organized unit moves.

Two different models were developed: one to estimate real resource costs and another to estimate Army budget costs, which, according to earlier research, will expand greatly the number of potential users. Next, a detailed breakdown of the cost elements was published to allow the users who have specific cost problems to tailor the final estimate to their needs.

#### MANPRINT

Blackwood, W.O., Dice, J.W. MANPRINT Primer. Alexandria, Va.: Automated Research Systems, Ltd., 1988.

This primer is designed for use by both Army and industry MANPRINT practitioners and provides a basis for their activities with specific how-to guidance to deal with MANPRINT issues that occur throughout the materiel acquisition life cycle. Chapter 1, an introduction to MANPRINT, provides the Army's conceptual basis and thrust for MANPRINT. In Chapter 2 and Appendix F, the primary roles and responsibilities for Army and industry are shown. Chapter 3 discusses various aspects of program management such as organization planning, scheduling, and resourcing of a comprehensive MANPRINT program throughout the design and development cycle. Chapter 4 concerns force level analyses, issues in each of the MANPRINT domains, and planning for and selecting analytical techniques and methodologies for use in obtaining needed information. Chapter 5 addresses future directions of the program.

Deppner, F.O., Nadler, L.B., Elder, B.L., and Harrison, O.J. Manpower and Personnel Requirements Determination Methodologies Manual (MANPERS Manual). Alexandria, Va.: General Research Corporation and Human Resources Research Organization, 1983.

The purpose of the Manpower and Personnel Requirements Determination Methodologies (MANPERS) manual is to provide:

1. Procedural guidance on how to formulate the Basis of Issue Plan Feeder Data (BOIPFD), the Qualitative and Quantitative Personnel Requirements Information (QQPRI), and the Basis of Issue Plan (BOIP).

2. Identification and discussion of data sources required for the correct and complete preparation of these documents.

3. Job aids and suggested work and recording sheets to assist in the preparation of these documents.

4. Cautionary, experiential, and highlighted advisory notes and information to assist in preparing these documents and to avoid deficiencies in data contained in them.

5. The flow of these documents from originating organizations through their various stages until approval and publication.

The manual also discusses the Life Cycle System Management Model (LCSMM) as used in the U.S. Army by certain service doctrines, pamphlets, and other guidance documents.

This manual is intended as a guide to assist Materiel and Combat Development personnel in determining and documenting personnel and equipment requirements for new equipment and weapons. Addressed are the processes for documenting changes in either personnel or equipment requirements at any stage in developing new equipment and weapons, in Product Improvement Programs (PIP), or in subsequent deployment which may impact one or more unit-type organizations at the Table of Organization and Equipment (TOE) level of force structure.

#### Task Data Bases

Anshro, T.M. Front-End Analysis: Configuring Occupational Data Input to Suit Output. Proceedings, 24th Annual Conference, Military Testing Association. Alexandria, Va.: Defense Logistics Agency, 1982.

This article discusses Navy occupational data input methodologies in both current and projected use and relates

their suitability for use in front-end job, task, and skill analysis (FEA). The purpose is to establish separate occupational data input and analysis for use as a "front end" to the Instructional Systems Development (ISD) System. This occupational data input should be essentially "raw": devoid of any analytical processes, evaluations, or judgments. This allows the data base to be used beyond the application of ISD. The assembled Job Task Inventories (JTIs) composed of distinct data blocks were used to comprise an occupational data base. The data blocks used were: Categorical (the task statement), Environmental (In what work-site environment is the task performed?), Identifying-supporting (With what supporting items, tools, and equipment is the task performed, and to what standard?), and Descriptive (What detailed supporting work behaviors describe or underlie task performance?). The data blocks were keyed to specific-action, object task statements rather than the generic statements common to the then-current occupational data banks. It was decided that the data base provided by the assembly should be complemented by a FEA system capable of operating within, among, and across occupational fields and yielding output data of sufficient specificity to support such activities as determining job-incumbent task-skill performance requirements and developing job-skill training programs.

Outputs of FEA should address such interrelationships among data elements as commonality and componency, and the perceived complexity in each task should be calculated and recorded. Task Complexity is indicated by a numerical index determined by quantifying task-descriptive data and should be a fixed factor, dependent upon measurable physical and mental characteristics of task performance requirements and component skills. Commonality concerns task-to-task relationships and is determined by matching identifying and descriptive factors task by task. Tasks should be considered common if all the descriptors of one identically match all those of another. Componency is a vertical hierarchy of work-behavior span, within which tasks of greater span superimpose on those of lesser span, given that all work behaviors of those tasks of lesser span are included in those tasks of greater span. Criticality is the measure of the importance of performing a certain task to the completion of a larger function. This factor is relevant to task elements as well as skill performance. The Adjunctive category was added to list further information, not descriptive of supporting work behaviors, to detail or further define the task-performance environment.

The results of the trial runs are as follows: internal outputs, such as complexity, commonality, and componency were useful and workable. Their use made possible computer separation of job-specific tasks and rating-specific skills, disclosed a high incidence of task commonality within and across associated

ratings, and provided prioritized task-skill lists for training purposes. Criticality was never successfully employed and was discontinued from use. It was possible for the computer to translate task statements into learning objective format and to print out curriculum outlines and billet descriptions. Occupational data collected by questionnaire for the subject FEA were deemed impractical due to the volume of data input.

The resulting JTIs for individual ratings ran to several thousand tasks listed. (Considered reasonable coverage for each rating). Manual data input gave way to use of a microcomputer for input, thus speeding up this process.

Davis, D. Totally Automated vs. Current Data Analysis for Navy ISD: A Cost Comparison. Proceedings of the 24th Annual Conference of the Military Testing Association. Alexandria, Va.: Defense Logistics Agency, 1982.

Davis compares the costs for storing, analyzing, and maintaining a totally automated data base for the Aviation Electrician's Mate (AE) to the costs of current data analysis, which includes both automated data storage, and use and analysis of SME judgments. The costs shown do not reflect total costs, but the differences between the two. These costs are presented in two categories: personnel-related and operating costs. The comparison revealed that the totally automated alternative was the more economically feasible choice, with total costs less than 60% of the current method.

Drucker, E.H., Hoffman, R.G., and Bessemer, D.W. A Comparison of Two Methods for Assessing Task Criticality. Proceedings of the 24th Annual Conference of the Military Testing Association. Alexandria, Va.: Defense Logistics Agency, 1982.

One of the problems experienced by training developers is the lack of time and resources to train all of the tasks performed by soldiers in a particular MOS. A solution advocated by TRADOC is to limit training to tasks that are most necessary for the successful accomplishment of the unit mission. This concept is task criticality. The purpose of this research was to compare judgments of task criticality based on scenarios with judgments using the ISD approach. In the results, no task appears among the five most or least critical using both types of questionnaires.

In the scenario approach, the context in which the tasks appear affected the ratings of task criticality for one-third of the tasks appearing in more than one scenario. There was a



significant task by questionnaire type interaction indicating the effects of questionnaire type varied with the task whose criticality was being measured.

Next, the tasks that would be chosen for training using each of the two types of questionnaires were examined, assuming that about half of the 51 tasks could be selected. It was found that 28% of the tasks selected for training would depend upon which method was used to determine task criticality.

After the administration of the ISD-type questionnaire, several of the respondents told the administrator the "the survey was a waste of their time and that judgments of task criticality could not be made without providing some context in which to make the judgments". (No critical comments were made regarding the scenario-based questionnaire.)

The results suggest that task criticality is dependent upon the situation in which the tasks occur. Since the training developer can select only a relatively few tasks for training, there is a possibility that a critical task could be overlooked. Since the results of this research has shown that not all ratings of task criticality are generalizable, and since the ISD method assumes the generalizability of all tasks, its continued use to determine task criticality should be reevaluated. However, future research must assess whether similar results would be obtained for other types of tasks performed in combat. The extent to which variations of task criticality are to be attributed to differences in combat operations as opposed to differences in combat situations also remains to be clarified.

Hayes, W.A. Selection of a Data Collection Methodology for Occupational Analysis. Proceedings of the 24th Annual Conference of the Military Testing Association. Alexandria, Va.: Defense Logistics Agency, 1982.

Since much effort has been made to analyze occupational data and little has been done to analyze input methodologies to determine the optimum method for collecting the raw data, the author compares the method of data collection in current use, the questionnaire, with an alternative collection method, observation, and addresses such issues as kind of information obtained, objectivity, and cost. The observation method is used in conjunction with the interview, using either a SME as the investigator, or by using the computer as a partial substitute for the investigator.

The questionnaire format, which can collect data from a large number of respondents in a relatively short time, is suitable for obtaining data regarding self-perceptions, judgments, and attitudes. It is less objective than the observation format and

is subject to bias and error. The observation method is well suited for the collection of factual "hard data", relating to performance, the end products of performance, or records. The cost for the two methods was approximately equal; however, the distribution between the time and the number of personnel involved differed. The questionnaire method utilized a large number of personnel for a relatively short time; while the observation method utilized a few personnel for a relatively long time.

Typically, manpower and personnel managers require broad descriptions and whole-job data, while training managers need detailed descriptions of work to provide the proper type and amount of training. In order for all three managers to use the same data base it must describe the tasks in detail, must be derived objectively, and must be produced inexpensively. Thus, since the costs are approximately the same, and since the precise data obtained by the observation method can serve all three managers, it should be the selected method to support the single data base of all occupational analysis.

Stephenson, R.W. A Taxonomic Base for Future Management Information and Decision Systems: A Common Language for Resource and Requirement Planning. Washington, D.C.: American Institutes for Research, 1972.

This paper outlines a preliminary plan for a common language which will improve communications between resource and requirement planners and facilitate the integration of information in centralized data banks. Army management information and decision systems are briefly reviewed, and methods to span the gulf between individual and organizational unit performance are analyzed with a new set of requirement planning procedures being devised. The new procedures ask requirement planners to use terms directly translatable into resource planning terms.

After systems analyses, four sets of planning procedures associated with four requirement planning documents were designed: unit capability tables, work activity sequence charts, performance standard tables, and personnel requirement tables. The implications of these requirement planning techniques for a new duty position-duty module system were described.

Given the assumption that the additional development work needed before the system is considered ready for implementation is completed successfully, the proposed system would appear to have many advantages. The most important would be improved communication between requirement and resource planners that should result in more effective meshing of operational personnel requirements of the organizational unit level with existing

individually described personnel resources, as well as an improvement in the prediction and evaluation of individual and organizational-unit competence.

Stephenson, R.W., Hadley, H.I., and Davis, W.P. A Comparison of Officer Job Content Modules with Activity Groupings Implicit in Course Design. Silver Springs, Md.: American Institutes for Research, Washington Offices, 1973.

The purpose of the study was to develop a system to improve communications between personnel resource planners and requirement planners and facilitate integration of common data bank information. The system being developed will be based on clusters of tasks that tend to go together occupationally and organizationally in meaningful ways. The Quartermaster position was analyzed using the modular approach since previous modules had only been based upon data on jobs filled by Infantry officers and it was uncertain whether a modular approach to officer jobs was feasible in the more specialized (Quartermaster) area.

The 63 positions filled by Quartermaster officers were subjected to job analyses. Eighty-nine job content modules were designed based on the Quartermaster job analyses and on 100 Infantry officer job analyses previously conducted. These modules accounted for at least 80% of the work performed for all the Infantry and Quartermaster officer positions for which the analysis information was obtained. There was considerable overlap in terms of job content modules of the two types of officers. The extent to which the job content modules could account for the positions filled by the officers was determined, as was the extent to which the job content modules were compatible with activity groupings implicit in the design of several officer courses of instruction. Comparing activity groupings implicit in course design with job content modules suggested that while the approaches were similar, there were significant differences. The degree to which one-to-one relationships can be made between course modules and job content modules appears to depend upon the extent to which the instruction is occupationally related.

To utilize these findings, the job content modules will be subjected to an experimental field test in which a large sample of Infantry and Quartermaster officers will be asked to describe their positions in duty module terms. If the modules pass the field test, work will be undertaken regarding the advantages and disadvantages of using officer duty modules to redesign selected officer personnel management procedures, tools, and techniques.

Tarr, R.W. Soft Skills Analysis: Two Proposed Methods for Analysis. Proceedings of the 24th Annual Conference of the Military Testing Association. Alexandria, Va.: Defense Logistics Agency, 1982.

A procedure is delineated for use in analyzing complex job skills as performed by senior NCO's and officers. The process examines total job requirements and attempts to sort out and identify what soft skills exist and how they fit and interact with the more discrete abilities and tasks. The process is as follows:

1. An initial list of fairly obvious skills is developed using an SME and a job analysis. (If one has been conducted.)
2. The context of a behavior is established as well as how the behavior fits into the total job and interacts with other skills.
3. One complex task is selected for analysis.
4. The initial analysis interview is conducted.
5. The analysis is repeated for each step of the scenario.
6. Each level one piece is broken down into actions, rules, and decisions.
7. A Matrix is constructed to graphically illustrate this process. The Actions and Tasks are listed across the top, while the Skills and Competencies are listed down the side. This reveals how several competencies impact on a single task as well as how a single competency spreads over several tasks.